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UNITED STATES DEPARTMENT OF AGRICULTURE
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TRAPS ATTACHED TO AIRCRAFT FOR
SAMPLING OF INSECT POPULATIONS

Plant Pest Control Division
Methods Improvement Operations

U. S. DEPT. OF AGRICULTURE
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Introduction

Traps attached to aircraft for sampling insect populations at various altitudes under a variety of atmospheric conditions have been in use since 1926. P. A. Glick of the former Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, recorded the initial attempts of airborne trapping at Tallulah, La. Several investigators have reported trapping studies by aircraft (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)¹.

Early collection flights utilized a wire screen coated with an adhesive. Control cables to open and close the traps were an early development because some investigators believed it was important to limit an exposure to a given altitude for a given period of time. Insects collected during these trapping operations were removed from the traps for study by taxonomists after the airplane returned to the airport.

Later trap designs have steadily progressed toward simplified, quick-disconnect types which can be exposed, retrieved, and replaced while the aircraft remains airborne. Flexible screening made it possible to design cone-shaped or sock-type traps. Closing such traps after exposure eliminated the need for adhesive and reduced drag considerably.

Traps that combine most of the desirable features of an airborne system (fig. 1) have been developed and used by the Plant Pest Control Division, Agricultural Research Service, U.S. Department of Agriculture, Hyattsville, Md. Each trap consists of a cone-shaped fiberglass net, steel mounting ring, nylon cord bridle, towing and retrieving lines, and a metal wing-strut attachment bracket. Snap buttons spaced along the rim of the net make each net detachable from the ring. This allows for quick changes in flight when more than one altitude must be sampled and permits use of nets of different mesh sizes. If immediate bottling of the insects is desirable, an aspirator hookup is available. At normal trapping speeds damage to the insects is minimal and most insects are identifiable. The hardy species are often alive and crawling when removed from the traps.

Although the trap is designed for installation on a Cessna 180,² it may be possible to obtain Federal Aviation Agency approval for its use on other aircraft types. Normally two traps are

¹ Numbers in parentheses refer to Literature Cited at end of publication.

² Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture over other products not mentioned.



Figure 1.--PPC aircraft with traps for sampling insect populations.

used at a time--one on each side of the aircraft. To use them, the windows must be a type that can be opened in flight and be large enough for the 21-inch traps to pass through them.

Details on constructing and installing the insect trap on a Cessna 180, as well as operating procedures of the aircraft and trap, are presented below.

Trap Specifications

The trap frame is made of a ring 21 inches in diameter ($1/4$ square yard in area) formed from $1/2$ -inch stainless steel tubing. A solid metal insert, crimped in place inside the ends of the tubing, holds the ring together. Such a frame could be made of any durable material of sufficient strength to withstand the drag loads exerted in flight.

The insect trap is made of 16- by 18-mesh fiberglass screening material which is rather flexible and easily folded. It is made in the shape of a modified frustum of a cone, 21 inches in diameter at the opening, 8 inches across the closed end, and 24 inches in length (fig. 2). A

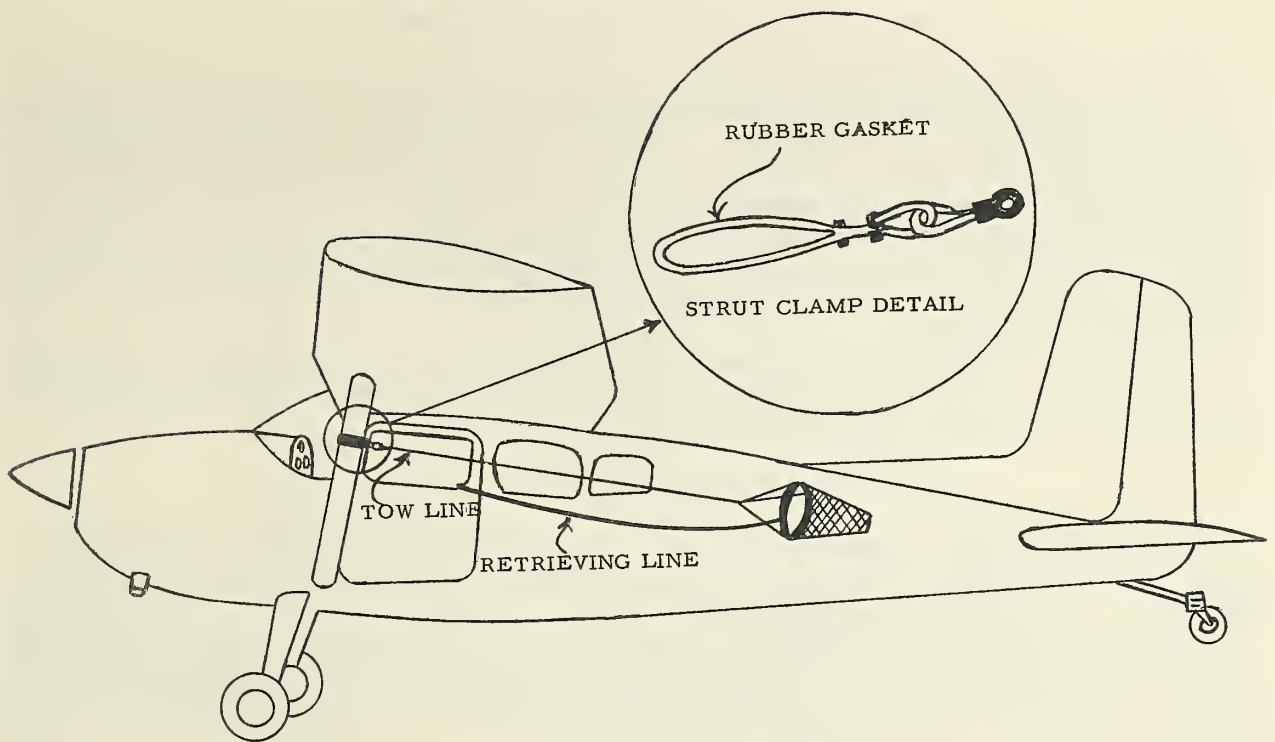


Figure 2.--Sketch of aircraft showing insect trap and attachments.

4-inch wide cotton sailcloth band is sewn to the open end of the trap netting. Twelve snap buttons, spaced uniformly at intervals along this band, allow for quick attachment of the trap to the frame.

Three 18-inch lengths of 1/8-inch nylon cord and a 1-inch harness ring form a bridle permanently tied to the trap frame. A 1/4-inch nylon tow line, 110 inches in length, attaches to the wing-strut bracket with a swivel snap. The same type of line, 95 inches in length tied to the ring that forms the trap, serves as a retrieving line. The retrieving line and the bridle stabilize the trap during trapping operations.

To make it easier to close tight-fitting windows, the 1/4-inch retrieving and tow lines may be replaced with four strands of 100-lb. test nylon cord. The four strands should be knotted together about every 12 inches to reduce tangling.

The wing-strut bracket is made of 0.035-inch 4130 chromemoly steel, 2 inches wide; form-fitted around the wing strut. When installed, a rubber gasket is placed between the strut and bracket to protect the strut metal. The bracket is attached 20 1/2 inches from the upper end of the wing strut. One AN3-10-32-5 bolt holds the rear end of the bracket together and incorporates a small clevis to hold the tow line snap (fig. 2).

Flight Test Results

Detailed flight tests were made to determine drag loads in pounds on the wing struts and the effect on flight characteristics of the aircraft. The drag load for each trap varied from 11 to 16 pounds at normal operating speeds of 60 to 80 miles per hour. The drag load increased to 32 pounds when the aircraft speed was increased to 120 m.p.h. These loads, including the one at 120 m.p.h. are well within engineering tolerances of the Cessna.

In addition to the drag-load tests, flight characteristics were checked with wing flaps set in all positions during steep turns and near stalls. The traps trailed smoothly under all conditions and caused no adverse effect on flight characteristics of the aircraft.

Total weight of two traps is approximately 4 pounds. Since this weight is suspended in air during trapping operations, weight and balance changes are negligible.

Federal Aviation Administration Approval

The FAA, Department of Transportation, has issued multiple certificates of airworthiness for the Cessna 180 aircraft used by the Plant Pest Control Division and a Cessna 172 used by the Indiana Department of Agriculture. Operations are authorized in both the standard and restricted classifications of airworthiness. For example, when the traps are installed, these airplanes are operated in restricted category. When the traps are removed, these airplanes revert back to standard category for carrying passengers or other activities. When an airplane is operated in restricted category, only the necessary crew may be carried--the pilot and trap operator. Applications for multiple certificates of airworthiness must be made to FAA for each aircraft that is converted.

A low-flying waiver is also necessary if trapping is to be done below 500 feet. Application to the local FAA district office should be made several weeks in advance listing pilot, aircraft type, and number and the area of proposed operations.

Flight Preparation

Remove the right front seat to allow more room for the observer to manipulate the traps in flight. Remove the screws from the window stop-arms to allow wider opening of the windows to facilitate extending and retrieving the traps.

Assemble all component parts of two complete traps and attach one complete trap to each wing strut. Tie the ends of the retrieving lines to the forward outboard seat-belt fittings. Pass the trap through the windows. During takeoff the traps remain in the cabin until the first trapping altitude is reached.

Trap Streaming Procedure

Reduce the forward speed of the aircraft to 80 m.p.h. or less. Slowly open the window through which the first trap is to be extended. (The propeller slip stream will hold the window open.) To minimize buffeting, make a further temporary power reduction as the trap is passed out through the window. The operator should maintain a firm grip on the retrieving line and the trap as he passes the trap in or out of the window. After the first trap is in position, close the window on the slack retrieving line and repeat the procedure with the second trap.

Exposure Procedure

During trap exposure, an aircraft speed of 60 to 80 m.p.h. is recommended in order to minimize damage to the insects. Whenever equal exposure time is desired for each trap, delay approximately 2 minutes before streaming the second trap. This is the average time required to complete a net change after an exposure has been made.

Trap Recovery Procedure

With the airspeed at 60 to 80 m.p.h. slowly open the window and pull the trap towards the window. As the trap is drawn near the fuselage, make another temporary power reduction to reduce buffeting and ease the air pressure exerted on the trap by the propeller slip stream. Grasp the net ring firmly and pull the trap into the cabin. After the trap is recovered, close the window.

Trap Changing Procedure

Unsnap the net from the ring and then flatten, fold, mark, and fasten it shut with a paper clamp to prevent the loss of surviving insects. If additional insect samples are desired, snap a fresh net onto the ring and repeat the trapping procedure.

Recovering Trapped Insects

Entomologists or observers ordinarily remove insects from the traps with an aspirator after the aircraft has landed. This serves as a means of gathering insects into a small container--usually a bottle--without damaging them.

A simple and rapid means of removing insects from the traps while the aircraft is in flight has also been developed. This can be done by attaching an aircraft venturi tube to the aircraft (fig. 3). This system features a standard 4-inch venturi normally used on small aircraft to create suction for gyro-operated navigational instruments. This venturi can be mounted on a standard 5-inch inspection plate under the cabin. Using a different flask for each area, altitude, or time period, an observer can easily classify trapped insects. While airborne, most observers find they can remove insects from the traps about as fast as they can change nets.

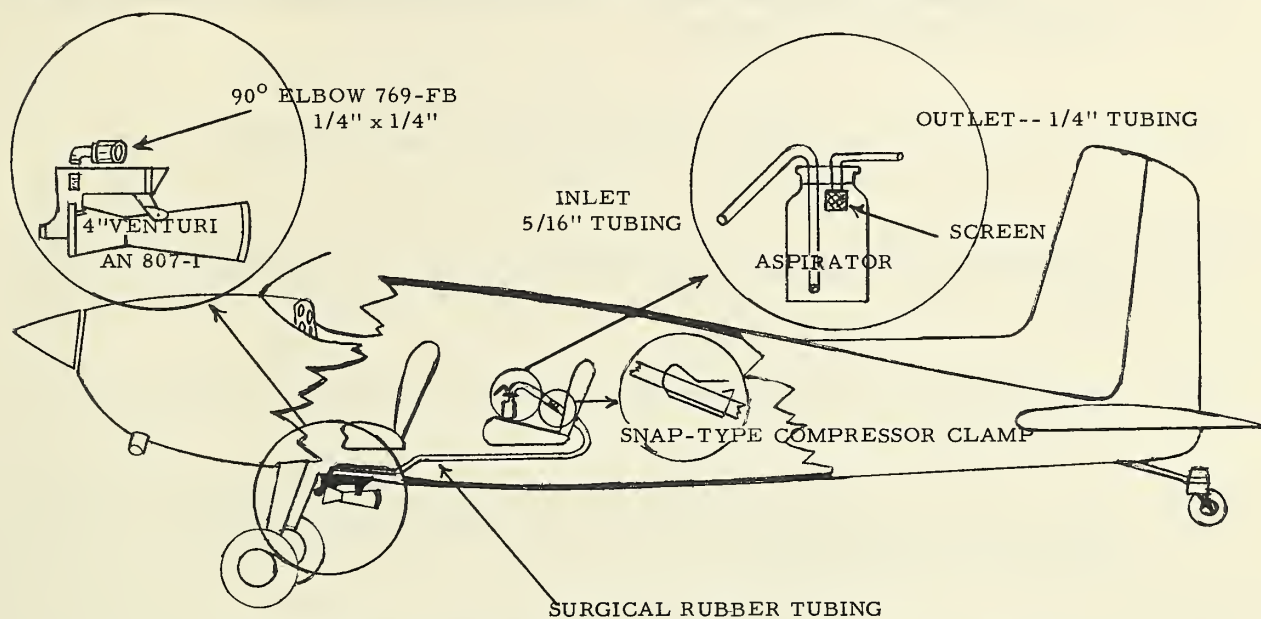


Figure 3.--Sketch of aircraft showing an aircraft venturi tube and aspirator.

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